

APPLICATION
FOR
UNITED STATES LETTERS PATENT

PATENT APPLICATION

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

Be it known that, Alan Chervitz of 4084 Arlington Drive, Palm Harbor, Florida 34685, T. Wade Fallin of 210 East 200 South, Hyde Park, Utah 84318 and Robert W. Hoy of 1504 South Talon Drive, Logan, Utah 84321 have invented certain improvements in APPARATUS AND METHOD FOR ORTHOPEDIC FIXATION of which the following description is a specification.

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MED-8 CIP

APPARATUS AND METHOD FOR ORTHOPEDIC FIXATION

Reference To Pending Prior Patent Application

This application is a continuation-in-part of
5 pending U.S. Patent Application Serial No. 09/863,174,
filed 05/23/01 by T. Wade Fallin et al. for APPARATUS
AND METHOD FOR ORTHOPEDIC FIXATION (Attorney's Docket
No. MED-8), which patent application is hereby
incorporated herein by reference.

Field Of The Invention

This invention relates to surgical apparatus and
methods in general, and more particularly to surgical
apparatus and methods for fixing bone and soft tissue
15 in place during trauma and reconstructive surgery.

Background Of The Invention

Bone fixation, sometimes also referred to as
fracture fixation, is an established art. Fixation
20 screws, and fixation screws in combination with metal
plates, are widely used in the art to stabilize bone so
as to facilitate healing.

Surgical cables, and surgical cables in combination with metal plates, are also well known in the bone fixation art. Cables, and cables in combination with plates, are generally used in situations where the use of screws, or screws in combination with plates, is not suitable. By way of example, cables, and cables in combination with plates, are frequently used in the fixation of long oblique fractures resulting from high energy trauma such as a motor vehicle accident. By way of further example, screw fixation is frequently not adequate for fractures that are highly comminuted, and fixation with cables, or cables in combination with plates, is required.

Cables are also sometimes used in conjunction with screws, and in conjunction with screws in combination with plates. By way of example, cables may be used in conjunction with screws, and screws in combination with plates, where a screw strips its threads in deployment, or where screws, or screws in combination with plates, are deemed insufficient for the fixation at hand.

With cable fixation, it is customary to encircle the subject bone with the body of the cable, and then

to secure the two free ends of the cable together with a deformable crimp so as to effect fixation.

In general, cable fixation on the shaft of a so-called "long bone" does not present a significant problem with migration, inasmuch as this portion of the bone is substantially tubular in geometry. However, the ends of these long bones typically have a significant flare in their geometry. As a result, tightening of the encircling cable often causes the cable (and crimp) to migrate toward the narrower section of the bone. Such migration can displace the cable sufficiently far from its intended location as to significantly loosen, or render ineffective, encirclement of the bone segments.

Thus, there is a need for an improved apparatus and method which will permit bone fixation to be effected with screws and cable.

There further exists a need for an improved apparatus and method for effecting bone fixation with cable, such that the cable will not slide along the bone during tightening of the cable.

In addition to the foregoing, in many situations, soft tissue may need to be attached to bone. By way of

example, a ligament may need to be attached to bone during trauma and reconstructive surgery. In some of these situations, bone fixation may also be necessary, and such bone fixation may involve the use of screws, and/or cables and plates, either alone or in combination with one another.

Thus, there is a need for an improved apparatus and method for attaching soft tissue to bone.

There further exists a need for an improved apparatus and method for attaching soft tissue to bone, where screws may be used to help effect fixation to bone.

Summary Of The Invention

Accordingly, one object of the present invention is to provide improved apparatus for use in bone fixation.

Another object of the present invention is to provide improved apparatus for use in bone fixation which involves the use of bone screws, metal plates and/or cables.

Still another object of the present invention is to provide an improved method for bone fixation.

Yet another object of the present invention is to provide improved apparatus for attaching soft tissue to bone.

5 And another object of the present invention is to provide improved apparatus for attaching soft tissue to bone, where screws may be used to help effect fixation to bone.

10 A further object of the present invention is to provide an improved method for attaching soft tissue to bone.

15 These and other objects of the present invention are addressed by the provision and use of a novel filament retaining washer for mounting about the shank of a bone screw deployed in a bone whereby to retain the filament to the bone, the filament retaining washer comprising a structure having a screw hole extending therethrough for receiving therein the shank of the bone screw deployed in the bone, whereby to secure the structure to the bone, the screw hole defining a first axis, and the structure having a filament hole
20 extending therethrough for receiving a filament therein so as to retain the filament to the structure, the filament hole defining a second axis extending

substantially perpendicular to the first axis, with the second axis being aligned with a bone screw extending through the screw hole.

In another form of the invention, there is provided a filament retaining washer for mounting about the shank of a bone screw deployed in a bone whereby to retain the filament to the bone, the filament retaining washer comprising a body; a downwardly projecting extension connected to the body and having a screw hole extending therethrough for receiving therein the shank of the bone screw deployed in the bone, whereby to secure the downwardly projecting extension to the bone, the screw hole defining a first axis; and an upwardly projecting extension connected to the body and having a filament hole extending therethrough for receiving a filament therein so as to retain the filament to the upwardly projecting extension, the filament hole defining a second axis extending substantially perpendicular to the first axis, with the second axis being aligned with a bone screw extending through the screw hole.

And in another form of the invention, there is provided a system for securing an object to a bone, the

system comprising a bone screw; a washer comprising a
body, a downwardly projecting extension connected to
the body and having a screw hole extending therethrough
for receiving therein the shank of the bone screw
5 deployed in the bone, whereby to secure the downwardly
projecting extension to the bone, the screw hole
defining a first axis, and an upwardly projecting
extension connected to the body and having a filament
hole extending therethrough, for receiving a filament
10 therein so as to retain the filament to the upwardly
projecting extension, the filament hole defining a
second axis extending substantially perpendicular to
the first axis, with the second axis being aligned with
a bone screw extending through the screw hole; and a
15 filament received by the filament hole, the filament
securing the object to the bone.

In another form of the invention, there is
provided a method for securing an object to a bone, the
method comprising providing a screw, a filament and a
20 suture retaining washer, the suture retaining washer
comprising a body, a downwardly projecting extension
connected to the body and having a screw hole extending
therethrough for receiving therein the shank of a bone

screw deployed in the bone, whereby to secure the
downwardly projecting extension to the bone, the screw
hole defining a first axis, and an upwardly projecting
extension connected to the body and having a filament
hole extending therethrough for receiving a filament
therein so as to retain the filament to the upwardly
projecting extension, the filament hole defining a
second axis extending substantially perpendicular to
the first axis, with the second axis being aligned with
a bone screw extending through the screw hole; securing
the washer to the bone with the screw, with the
filament extending through the filament hole; and
using the filament to secure the object to the bone.

And in another form of the invention, there is
provided a method for securing an object to a bone, the
method comprising providing a screw, a filament and a
suture retaining washer, the suture retaining washer
comprising a structure having a screw hole extending
therethrough for receiving therein the shank of the
bone screw deployed in the bone, whereby to secure the
structure to the bone, the screw hole defining a first
axis, and the structure having a filament hole
extending therethrough for receiving a filament therein

so as to retain the filament to the structure, the filament hole defining a second axis extending substantially perpendicular to the first axis, with the second axis being aligned with a bone screw extending through the screw hole; securing the washer to the bone with the screw, with the filament extending through the filament hole; and using the filament to secure the object to the bone.

In another form of the invention, there is provided a filament retaining washer for mounting about the shank of a bone screw deployed in a bone whereby to retain the filament to the bone, the filament retaining washer comprising: a body; a downwardly projecting extension connected to the body and having a screw hole extending therethrough for receiving therein the shank of the bone screw deployed in the bone, whereby to secure the downwardly projecting extension to the bone, the screw hole defining a first axis; and an upwardly projecting extension connected to the body and having a filament hole extending therethrough for receiving a filament therein so as to retain the filament to said upwardly projecting extension, the filament hole defining a second axis extending substantially

perpendicular to the first axis, with the upwardly projecting extension being displaced laterally and longitudinally from the downwardly projecting extension.

5 In another form of the invention, there is provided a filament retaining washer for mounting about the shank of a bone screw deployed in a bone whereby to retain the filament to the bone, the filament retaining washer comprising: a structure having a screw hole
10 extending therethrough for receiving therein the shank of the bone screw deployed in the bone, whereby to secure the structure to said bone, the screw hole defining a first axis, and the structure having a filament hole so as to retain the filament to the
15 structure, the filament hole defining a second axis extending substantially perpendicular to the first axis, with the second axis extending parallel to a third axis extending through the first axis.

20 The above and other features of the invention, including various novel details of construction and combinations of parts, will now be more particularly described with reference to the accompanying drawings and pointed out in the claims. It will be understood

that the particular devices, assembly and method
embodying the invention are shown by way of
illustration only and not as limitations of the
invention. The principles and features of this
5 invention may be employed in various and numerous
embodiments without departing from the scope of the
invention.

Brief Description Of The Drawings

10 These and other objects and features of the
present invention will be more fully disclosed or
rendered obvious by the following detailed description
of the preferred embodiments of the invention, which is
to be considered together with the accompanying
15 drawings wherein like numbers refer to like parts, and
further wherein:

Fig. 1 is a perspective view showing a novel
surgical fastening system securing together two bone
segments;

20 Fig. 2 is perspective view of a cable retaining
washer which forms part of the surgical fastening
system shown in Fig. 1;

Fig. 3 is an exploded side view, in section, of a bone screw, cable retaining washer and bone plate which form part of the surgical fastening system shown in Fig. 1;

5 Fig. 4 is a perspective view of an alternate form of cable retaining washer formed in accordance with the present invention;

10 Fig. 5 is a perspective view of another alternative form of cable retaining washer formed in accordance with the present invention;

Fig. 6 is a perspective view of still another alternative form of cable retaining washer formed in accordance with the present invention;

15 Fig. 7 is a perspective view of yet another alternative form of cable retaining washer formed in accordance with the present invention;

Fig. 8 is a perspective view of a bone screw, cable retaining washer and bone plate which comprise another embodiment of the present invention;

20 Fig. 9 is a side view, in section, of the apparatus shown in Fig. 8;

Fig. 10 is a side view, partially in section, showing a bone screw securing the cable retaining washer of Fig. 2 directly to a bone;

Fig. 11 is a perspective view showing an alternative form of surgical fastening system formed in accordance with the present invention;

Fig. 12 is a perspective view of a suture retaining washer which forms part of the surgical fastening system shown in Fig. 11;

Fig. 13 is a partial sectional view of a bone screw and suture retaining washer which form part of the surgical fastening system shown in Fig. 11;

Fig. 14 is a perspective view showing a suture loop attaching a piece of surgical mesh to a suture retaining washer;

Fig. 15 is a view similar to that of Fig. 11, except showing the assembly of Fig. 14 secured to a bone;

Figs. 18-16 are schematic views showing another alternative form of cable retaining washer;

Fig. 19 is a schematic view showing another alternative form of cable retaining washer;

Fig. 20 is a schematic view showing still another alternative form of cable retaining washer;

Fig. 21 is a schematic view of yet another form of cable retaining washer;

5 Fig. 22 is a schematic view of another form of cable retaining washer;

Fig. 23 is a schematic view of another form of cable retaining washer; and

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Fig. 24-26 are schematic views showing an alternative form of suture retaining washer.

Detailed Description Of The Preferred Embodiments

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Looking first at Figs. 1-3, there is shown a surgical fastening system 5 which comprises one preferred form of the invention.

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Surgical fastening system 5 generally comprises a bone plate 6, a plurality of bone screws 9, a plurality of cable retaining washers 12, and a plurality of cable loops 15. As used herein, the term "cable" is intended to encompass braided cable, wire and the like.

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Bone plate 6 is deployed so that the bone plate extends across the fracture line 18 of two bone

segments 20, 21. The heads 25 (Fig. 3) of bone screws
9 engage cable retaining washers 12, while the shanks
27 of bone screws 9 extend through screw holes 30 in
cable retaining washers 12, through screw holes 33 in
bone plate 6 and into bone segments 20, 21, whereby to
secure bone plate 6 to bone segments 20, 21 and, the in
process, to secure bone segments 20, 21 together.
Additionally, cable loops 15 encircle bone segments 20,
21 and are secured to cable retaining washers 12,
whereby cable loops 15 further secure bone segments 20,
21 to bone plate 6 and, as a result, to one another.

Bone plate 6 is of the sort well known in the art.
By way of example but not limitation, bone plate 6
generally comprises an elongated body 35 penetrated by
the aforementioned screw holes 33. The bone plate's
top surface 36 generally includes recesses 40 about the
top ends of screw holes 33; in conventional bone plate
applications, recesses 40 receive the semi-spherical
undersides of the heads 25 of bone screws 9.

Bone screws 9 are also of the sort well known in
the art. Bone screws 9 comprise the aforementioned
head 25 and the aforementioned shank 27.

Cable restraining washer 12 comprises a body 45 having a bottom surface 48 (Fig. 3) for engaging the top surface 36 of bone plate 6, a downwardly projecting extension 50 for seating in a recess 40 in bone plate 6, and an upwardly projecting extension 55 for receiving and restraining at least one cable loop 15.

Downwardly projecting extension 50 preferably has a semi-spherical configuration similar to the semi-spherical underside of a head 25 of a bone screw 9 so as to seat in one of the recesses 40 commonly formed in bone plate 6.

A recess 60 is formed in body 45, in alignment with the downwardly projecting extension 50 and screw hole 30. Recess 60 is sized so as to receive the head 25 of a bone screw 9, and screw hole 30 is sized so as to receive the shank 27 of a bone screw 9. In this way, cable restraining washer 12 can be mounted to bone plate 6 so that the washer's downwardly projecting extension 50 seats in a recess 40 formed in bone plate 6, and a bone screw 9 may be passed through the cable retaining washer 12 so that the head 25 of the screw 9 is seated in the washer's recess 60 and so that the shank 27 of the bone screw 9 passes through the

washer's screw hole 30, through the screw hole 33
formed in bone plate 6, and into a bone segment 20, 21,
whereby to secure the cable retaining washer 12 and
bone plate 6 to one another, and to a bone segment 20,
21.

Cable retaining washer 12 also comprises the
upwardly projecting extension 55 for receiving and
retaining one or more cable loops 15. More
particularly, cable retaining washer 12 also comprises
at least one cable hole 65 extending perpendicular to
the axis of the washer's screw hole 30. Cable hole 65
is sized to slidably receive a cable loop 15. A
threaded set screw hole 67 extends downwardly from the
top surface 70 of the washer's upwardly projecting
extension 55. The bottom end of set screw hole 67
intersects the at least one cable hole 65 (Fig. 3). A
set screw 73 is positioned in set screw hole 67. Set
screw 73 may be tightened down so as to engage a cable
loop 15 extending through a cable hole 65, whereby to
secure that cable loop to the cable retaining washer 12
and, as a result, to secure that cable loop to a bone
segment 20, 21.

Surgical fastening system 5 is intended to be used as follows.

First, bone plate 6 is positioned against bone segments 20, 21. Then bone screws 9 are used to secure cable retaining washers 12 and bone plate 6 to one another and to bone segments 20, 21. Next, cable loops 15 are passed through cable holes 65 in the cable retaining washers 12, and then set screws 73 are used to lock cable loops 15 to the washers.

Looking next at Fig. 4, there is shown a cable retaining washer 112 which comprises an alternative form of the invention. Cable retaining washer 112 is substantially the same as the cable retaining washer 12 described above, except that it also includes a second upwardly projecting extension 55, along with that extension's associated cable hole(s) 65, set screw hole 67, and set screw 73.

Looking next at Fig. 5, there is shown a cable retaining washer 212 which comprises another alternative form of the invention. Cable retaining washer 212 is substantially the same as the cable retaining washer 12 described above, except that its upwardly projecting extension 255 lacks the set screw

hole 67 and set screw 73 for locking a cable loop 15 within a cable hole 65. Instead, with cable retaining washer 212, upwardly projecting extension 255 is formed so as to be crimpable, whereby to mechanically lock a cable loop 15 within a cable hole 65. In one preferred form of the invention, upwardly projecting extension 255 is formed with a trapezoidal cross-section such as that shown in Fig. 5, whereby to facilitate crimping of the upwardly extending projection 255 about the cable.

Looking next at Fig. 6, there is shown a cable retaining washer 312 which comprises another alternative form of the invention. Cable retaining washer 312 is substantially the same as the cable retaining washer 212 described above, except that it includes a second upwardly projecting extension 255.

Looking next at Fig. 7, there is shown a cable retaining washer 412 which comprises another alternative form of the invention. Cable retaining washer 412 is substantially the same as the cable retaining washer 312 described above, except that each of the upwardly projecting extensions 255 has only one cable hole 65 formed therein.

In the cable retaining washers 12, 112, 212, 312 and 412 described above, the downwardly projecting extension 55 has a semi-spherical configuration so as essentially replicate the semi-spherical underside of the head 25 of a bone screw 9, whereby it may be received in the recess 40 formed in bone plate 6. However, forming the downwardly projecting extension 55 with a semi-spherical configuration can sometimes result in the cable retaining washer turning somewhat about the axis of its screw hole 30 as bone screw 9 is screwed into a bone segment 20, 21. This can present an inconvenience to the surgeon.

To guard against this, and looking now at Figs. 8 and 9, there is shown a bone plate 506 which is provided with an elongated recess 540 and a cable retaining washer 512. Cable retaining washer 512 is substantially the same as the cable retaining washer 212 shown in Fig. 5, except that the downwardly projecting extension 50 of cable retaining washer 212 (Fig. 5) has been replaced with a downwardly projecting extension 550 having a cross-sectional profile matching that of the bone plate's elongated recess 540. If desired, the cable retaining washers 12, 112, 312, and

412 may also have their downwardly projecting extensions 50 replaced with similar downwardly projecting extensions 550, whereby they can mate securely with recesses 540 of a bone plate 506.

5 It is also possible to use the cable retaining washers of the present invention without a bone plate. In this case, the bone screw passes through the cable retaining washer and directly into a bone segment 20, 21. If desired, cable retaining washers 12, 112, 212, 312, 412 and/or 512 may be used in this way, with the
10 downwardly projecting extensions bearing against, and generally penetrating into, bone segment 20, 21. See, for example, Fig. 10, where cable retaining washer 12 is shown engaging a bone segment 20, 21.

15 Alternatively, if desired, the bottom surface of the cable retaining washer can be modified so as to reduce, or entirely remove, the downwardly projecting extension.

20 Looking next at Figs. 11-13, there is shown a suture retaining washer 612 which comprises another form of the invention. Suture retaining washer 612 comprises a body 645. Suture retaining washer 612 also comprises a downwardly projecting extension 650 for

seating in a recess 40 of a bone plate 6 or for
engaging the outer surface of a bone segment 20, 21.
Suture retaining washer 612 also comprises at least one
upwardly projecting extension 655 for receiving and
retaining at least one suture loop 615.

A screw hole 30 is formed in downwardly projecting
extension 650 and a recess 60 is formed in body 645.
Recess 60 is sized to receive the head 25 of a bone
screw 9, and screw hole 30 is sized to receive the
shank 27 of bone screw 9. In this way, suture
retaining washer 612 can be mounted to bone plate 6 so
that the downwardly projecting extension 650 seats in a
corresponding recess 40 in bone plate 6, and a bone
screw 9 may be passed through the suture retaining
washer 612 so that the head 25 of the screw 9 is seated
in the washer's recess 60 and the shank 27 of the bone
screw 9 passes through the washer's screw hole 30,
through the screw hole 33 in bone plate 6, and into a
bone segment 20, 21, whereby to secure suture retaining
washer 612 and bone plate 6 to one another, and to a
bone segment 20, 21. Alternatively, suture retaining
washer 612 can be mounted directly to a bone segment
20, 21 by seating downwardly projecting extension 650

against a bone segment 20, 21, and then passing a bone screw 9 through the suture retaining washer 612 so that the head 25 of the screw 9 is seated in the washer's recess 60 and the shank 27 of the bone screw 9 passes through the washer's screw hole 30 and into a bone segment 20, 21.

Suture retaining washer 612 also comprises at least one upwardly projecting extension 655 for receiving and retaining one or more loops 615. More particularly, suture retaining washer 612 also comprises at least one upwardly projecting extension 655, with each upwardly projecting extension having at least one suture hole 65 extending perpendicular to the axis of the washer's screw hole 30. Suture hole 65 is sized to slidably receive a suture loop 615.

If desired, suture loops 615 can be used to secure soft tissue to bone segments 20, 21. Alternatively, and looking next at Figs. 14 and 15, suture loops 615 can be used to attach a surgical mesh 675 to bone segments 20, 21, or to attach other objects to bone segments 20, 21.

Looking next at Figs. 16-18, there is shown a cable retaining washer 712 which comprises an

alternative form of the invention. Cable retaining washer 712 is substantially the same as the cable retaining washer 212 described above, except that its upwardly projecting extension 755 has its one or more cable holes 65 extending along an axis substantially aligned with the head 25 of screw 9. Again, the upwardly projecting extension 755 may be crimped about a cable loop 15 extending through a cable hole 65.

Looking next at Fig. 19, there is shown a cable retaining washer 812 which comprises another alternative form of the invention. Cable retaining washer 812 is substantially the same as the cable retaining washer 712 described above, except that it includes a second upwardly projecting extension 755 which also has its one or more cable holes 65 substantially aligned with the head 25 of screw 9. Again, the upwardly projecting extensions may be crimped about a cable loop 15 extending through a cable hole 65.

Looking next at Fig. 20, there is shown a cable retaining washer 912 which comprises another alternative form of the invention. Cable retaining washer 912 is substantially the same as the cable

retaining washer 12 described above, except that its upwardly projecting extension 955 has its one or more cable holes extending along an axis substantially aligned with the head 25 of screw 9. Again, set screw 78 may be tightened down so as to secure a cable loop 15 to the cable retaining washer.

Looking next at Fig. 21, there is shown a cable retaining washer 1012 which comprises another alternative form of the invention. Cable retaining washer 1012 is substantially the same as the cable retaining washer 912 described above, except that it includes a second upwardly projecting extension 955 which also has its one or more cable holes 65 substantially aligned with the head 25 of screw 9. Again, a set screw 78 may be tightened down so as to secure a cable loop 15 to the cable retaining washer.

Looking next at Fig. 22, there is shown a cable retaining washer 1112 which comprises another alternative form of the invention. Cable retaining washer 1112 is substantially the same as the cable retaining washer 212 described above, except that the upwardly projecting extension 255 is replaced with a displaced extension 1155 having one or more cable holes

65 extending therethrough. More particularly,
displaced extension 1155 is preferably formed in the
same plane as body 45 and downwardly projecting
extension 50, and is displaced both laterally (i.e.,
5 along the axis labeled "X" in Fig. 22) and
longitudinally (i.e., along the axis labeled "Y" in
Fig. 22) from downwardly projecting extension 50. By
displacing extension 1155 laterally and longitudinally
away from downwardly projecting extension 50, access to
10 the extension 1155 with a crimping tool is enhanced.

Looking next at Fig. 23, there is shown a cable
retaining washer 1212 which comprises another
alternative form of the invention. Cable retaining
washer 1212 is substantially the same as the cable
retaining washer discussed above, except that it
15 includes a second displaced extension 1155. In one
preferred embodiment, the one or more cable holes 65 of
one displaced extension 1155 are aligned with the one
or more cable holes 65 of the other displaced extension
20 1155. In another preferred embodiment, the two
displaced extensions 1155 may be diametrically opposed
from one another.

Looking next at Figs. 24-26, there is shown a suture retaining washer 1312 which comprises another alternative form of the invention. Suture retaining washer 1312 is substantially the same as the suture retaining washer 612 described above, except that body 645 and upwardly projecting extensions 655 are omitted, and the at least one suture hole 65 is formed directly in the side wall of downwardly projecting extension 650. Preferably at least two suture holes 65 are provided, and the two suture holes are aligned with one another so as to receive a single suture loop 615 therethrough, such as is shown in Fig. 26. Preferably each suture hole 65 has its entrances and rounded somewhat so as to permit the suture to be slidingly adjusted therethrough prior to fully tightening down bone screw 9. However, suture retaining washer 1312 may, optionally, be constructed so that the head of the bone screw will lock the suture to the washer when the bone screw is fully tightened down. Suture retaining washer 1312 may be secured directly to a bore segment 20, 21 if desired, or it may be secured to a bone plate which is disposed between suture retaining washer 1312 and a bone segment 20, 21. Suture retaining washer

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